

Dec. 6, 1966

J. D. RAMSAY

3,289,832

SELECTOR SYSTEM

Filed Sept. 24, 1963

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FIG. 1.

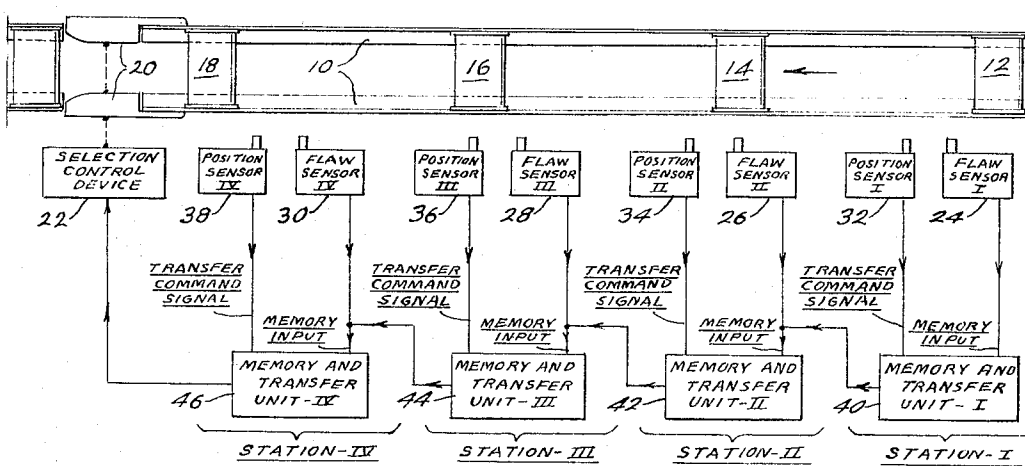


FIG. 2.

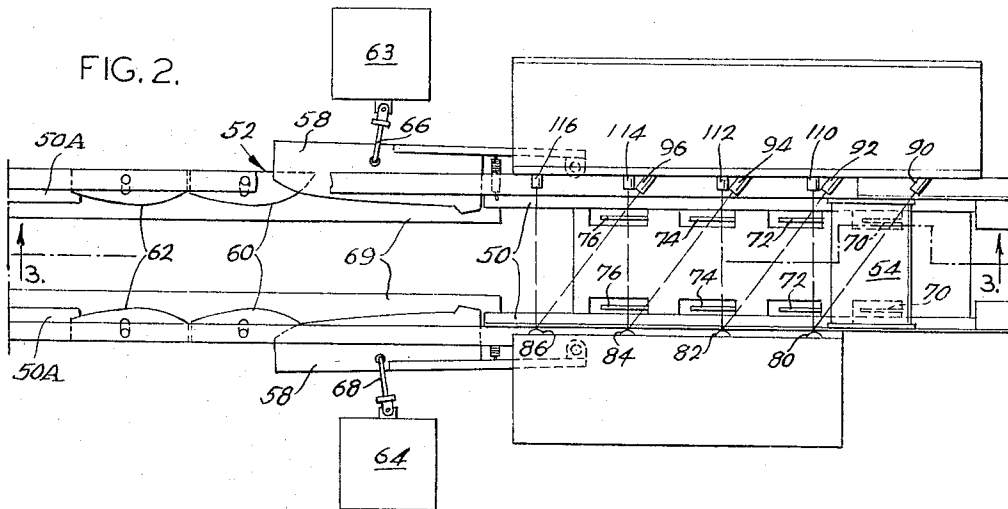
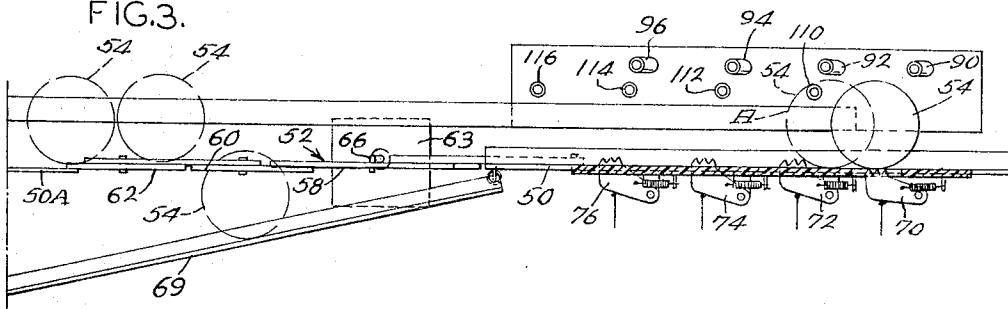


FIG. 3.



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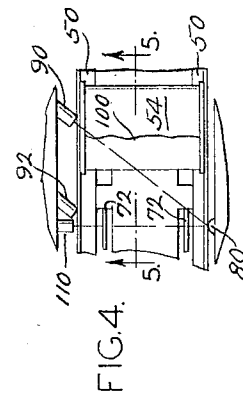
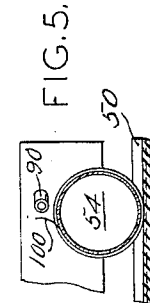
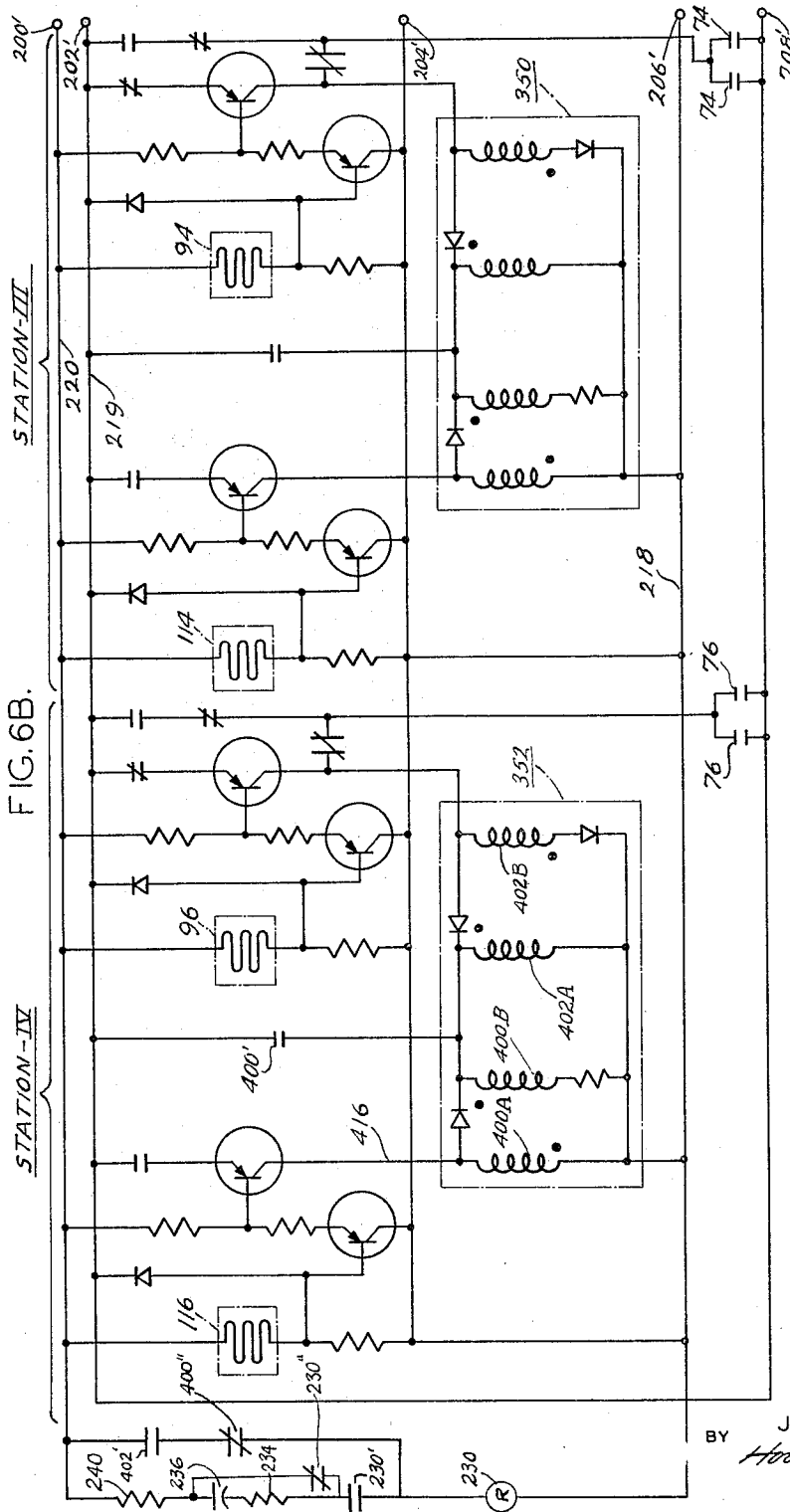
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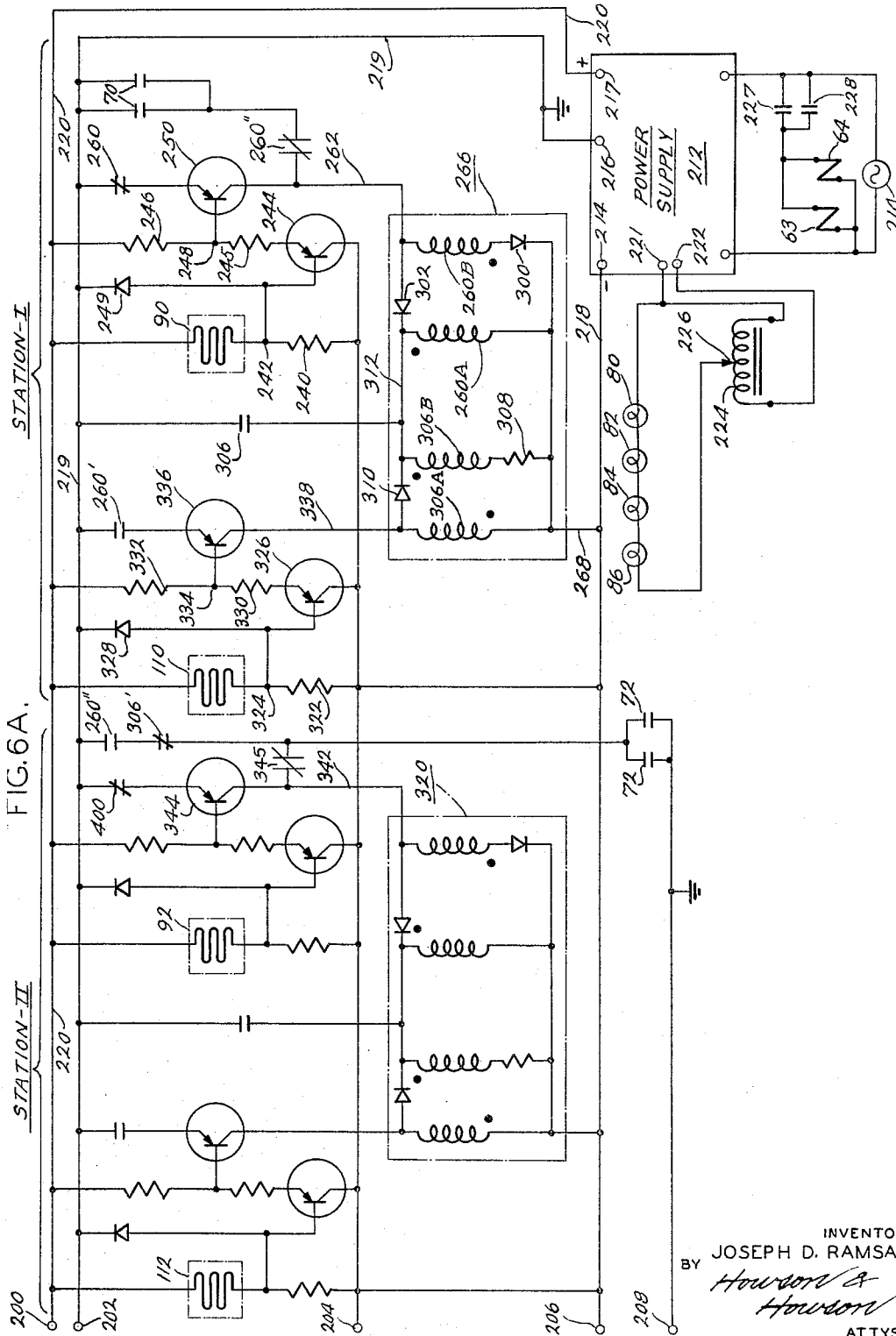
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SELECTOR SYSTEM

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Filed Sept. 24, 1963, Ser. No. 311,060
12 Claims. (Cl. 209-75)

This application is a continuation-in-part of copending application Serial No. 281,387, filed May 16, 1963, and entitled "Selector System," now abandoned.

The present invention relates to apparatus for selecting faulty of flaw-containing objects from a train of objects moving along a predetermined path, and particularly to such apparatus which is suitable for diverting from a train of moving containers, such as metal cans, those containers having detectable flaws such as misplaced labels for example.

Apparatus is known in the prior art which is capable of detecting one or more types of flaws in objects moving in a series train and momentarily opening a diverting path in front of the flaw-containing object in response to a signal from the flaw-sensing apparatus. For example, it is known to place a light source and a photocell on opposite sides of a track on which there moves a train of rolling cans of cylindrical shape intended to have labels affixed tightly around the centers of their cylindrical surfaces, the light source and photocell being so placed that if the label is not properly affixed to the cylindrical surface, but is partially loose so as to protrude from the cylindrical surface, the protruding portion of the label may intercept the light from the source and produce a signal at the photocell to actuate a diverting mechanism immediately in front of the light source-photocell combination. It is also known to utilize electrical contacts positioned adjacent the track in such position that as each can passes it is touched by the electrical contactor on a portion which is intended to be covered by the electrically non-conductive label, so that if the label does not cover this portion of the can surface an electrical circuit will be completed by way of the conductive can, again to provide a signal for actuating the diverted mechanism. However, I have found that such arrangements are not entirely satisfactory in all applications for the reason that they normally provide indications of only those flaws occurring at one limited circumferential portion of the can, for example that portion touched by an electrical contractor or that portion which passes nearest to the light beam travelling from the light source to the photocell. In such arrangements flaws existing in other circumferential portions of the cans may then pass the flaw-sensing apparatus without being detected, and hence many faulty cans will not be diverted from the train.

Accordingly, it is an object of my invention to provide improved apparatus for detecting flaws in a trail of objects moving in sequence along a predetermined path.

Another object is to provide such improved apparatus which derives signals indicative of such flaws and employs these signals automatically to divert from the train those objects containing the detected flaws.

A further object is to provide flaw-detecting apparatus spaced along the path of a train of rolling objects so as to obtain indications at points along said path of flaws

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in different, circumferentially-spaced portions of said objects.

Another object is to provide such apparatus in which flaws in substantially all circumferentially-spaced portions of the object are detected.

It is also an object to provide diversion from a train of objects of only those objects containing flaws detected at any of a plurality of spaced points along the path of motion of the objects.

Another object is to provide apparatus for deriving indications of flaws in moving objects at a plurality of points along the path through which the objects move, and for utilizing such indications to actuate a diverting mechanism for the objects at a proper later time such as to divert only those objects in which flaws were earlier detected.

It is also an object to provide apparatus for detecting flaws, such as improper labelling, in a plurality of cylindrical cans at spaced points along a track over which the cans roll on their cylindrical surfaces, and to supply signals indicative of such detected flaws to a common diverting mechanism located further along said track at a location following said sensing apparatus, in such manner that the diverting mechanism is actuated only when flaw-containing cans reach it, despite changes in the velocity and mutual spacing of the cans along the portion of the track in which the flaws are detected.

In accordance with the invention the above objects are achieved by providing a plurality of flaw-detecting stations spaced along the path travelled by moving objects, such as rolling cans, so that additional information as to the presence of flaws in the objects may be obtained, and using signals derived from such flaw-detecting stations to operate a single diverting mechanism spaced beyond the flaw-detecting apparatus in the direction of motion of the objects. In applications of the invention to a train of rolling cans the several stations are preferably spaced along the track so that rolling of the cans between stations presents different circumferential portions of the can to the sensing apparatus at the different stations. Preferably the plurality of stations in the latter example are disposed along a portion of the track substantially equal in length to the rolling circumference of the can, and preferably the number of stages and the fraction of the circumference of the can monitored by the sensing apparatus at each station is such that the plurality of sensing stations together provide monitoring of substantially the entire circumference of the can.

In such apparatus using a plurality of flaw-detecting stations and a common diverting mechanism a special problem arises due to the fact that flaw indications derived at any particular station with respect to a given can must be applied to operate the selector only when that same can arrives at the selector. Where the velocity of motion of the cans is uniform this can be accomplished by providing an appropriate fixed signal delay between each flaw-detecting station and the selector mechanism. However in general the velocity and spacing of the cans along the track may vary substantially, at different times and for different cans. Accordingly, use of such a fixed signal delay would actuate the selector mechanism at the wrong times as soon as the can velocity departed from a particular fixed value.

In accordance with an important feature of the invention this difficulty is overcome by utilizing a plurality of

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position-sensing devices spaced along the path of the floating objects, preferably with one such device immediately following each flaw-sensing device, which position-sensing devices provide separate signals indicative of the attainment by each can of a particular position along the track; further, signals from the flaw-sensor and from the position-sensor at each station are supplied to a corresponding memory and transfer unit which stores the corresponding flaw-indicating signal until the corresponding position-indicating signal causes the flaw-sensing signal to be transferred to the memory and transfer unit for the next succeeding station; at the last station, the position-sensing signal causes any stored flaw-indicating signal to be transferred to the selector mechanism to divert the faulty can. Each position-sensor is spaced with respect to its associated flaw-detector so that each stored flaw-indicating signal produced by a given can is transferred only by a position-indicating signal produced by the same can at the same station. This arrangement is such that when a flaw is detected at any of the stations it will be momentarily stored in the corresponding memory circuit, will pass from memory unit to memory unit in sequence as the can passes successive position-sensing stages, and will reach the selector mechanism at the same time as the can in which the fault was detected. A fault may be detected and passed along to the selector mechanism from any one of the flaw-sensing stages, and if flaws are detected at more than one station a proper flaw-indicating signal is still passed along through the successive memory and transfer units in proper timed sequence to the selector.

Thus in a primary application of the invention to diversion of faultily-labelled cans, a train of rolling cans are subjected to monitoring to detect mis-labelling at a plurality of positions along the track and at a plurality of circumferential portions of the cans, and any flaws detected are represented by flaw-indicating signals which effectively pass along through successive memory circuits as the can moves along the track so that each flaw-indicating signal reaches the selector for diverting faulty cans at the same time that the corresponding faulty can reaches said selector. Because upon transfer of fault-indicating signals from one memory circuit to the next the memory circuit is returned to its original state, it is immediately ready for use as a memory element for a flaw-indicating signal produced by the immediately-succeeding can, and flaw-indicating signals from a plurality of cans may move simultaneously in sequence through the series of memory circuits toward the selector. In this way the extent of automatic surveillance of the cans is extended, and the faulty can selector actuated at the proper time, despite large changes in the velocity and spacings of cans in the train.

These and other objects and features of the invention will be more fully appreciated from consideration of the following detailed description, taken in connection with the accompanying drawings, in which:

FIGURE 1 is a diagrammatic showing, principally in block form, illustrating the over-all organization of a system in accordance with the invention;

FIGURE 2 is a top plan view of a physical arrangement of elements in accordance with the invention;

FIGURE 3 is a side-view section taken along lines 3-3 of the apparatus of FIGURE 2;

FIGURE 4 is a fragmentary top view of a portion of the system of FIGURES 2 and 3 illustrating the function of the photoelectric detector of loose labels employed therein;

FIGURE 5 is a side sectional view along lines 5-5 of the apparatus of FIGURE 4; and

FIGURES 6A and 6B together constitute a schematic diagram of electrical apparatus used in a preferred form of the invention.

Referring now particularly to the simplified illustrative diagram of FIGURE 1, in which the positions of the various elements and the dimensions of the track and cans

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are not necessarily to scale, there is shown a track 10 along which a plurality of objects such as 12, 14, 16 and 18, typically rolling metallic cans, move from right to left in the figure. At the extreme left there is a diverting mechanism 20 operated by a selection control device 22 for the purpose of diverting from the main track those cans containing certain types of flaws, such as loose or misplaced labels on the cylindrical surfaces of the cans. Spaced along the track at equal intervals from right to left are four flaw sensors 24, 26, 28 and 30, each immediately followed by corresponding position sensors 32, 34, 36 and 38 respectively. Thus each associated pair of flaw-sensor and position-sensor comprises a separate station along the track, four such stations being shown in FIGURE 1. Also associated with these four stations, extending from right to left, are the four respective memory and transfer units 40, 42, 44 and 46, each of which is responsive to an input signal from its corresponding flaw sensor or from the transfer output of a preceding memory and transfer unit to store such input signal until provided with a signal from the corresponding position-sensor, at which time the stored signal is transferred to the next memory and transfer unit, or in the case of unit 46 to the selection control device 22. After transfer, each memory and transfer unit is automatically reset to its original condition receptive to other input signals.

In operation, if a can passes along a track without any flaw being detected at any station, it will continue along the track past the selector 20 without being diverted. If a flaw is sensed at station I, a flaw-indicating signal from sensor 24 is applied to the memory input of memory and transfer unit 40, and when the can reaches position-sensor 32 the latter apparatus applies a transfer command signal to unit 40 which causes the flaw-indicating signal stored in the latter unit to be transferred to the memory section of the next memory and transfer unit 42, at the same time resetting unit 40 to its original condition. If for the same can no flaws are detected at stations II, III, or IV, arrival of the can at position-sensor 34 will cause the signal stored in unit 42 to shift to the next unit 44, arrival of the can at position sensor 36 will cause the stored signal to be shifted from unit 44 to unit 46, and arrival of the can at the last position-sensor 38 will cause the signal stored in unit 46 to be shifted to the selection control device 22 at the proper time to operate the selector 20 to remove the can from the main track. If instead a flaw is also detected in the latter can by the flaw-sensor in any of the stages II, III or IV, this has no further effect upon the corresponding memory and transfer unit, which already contains a flaw-indicating signal shifted thereto from the preceding unit, and there is therefore no interference with the proper operation of the selector at the proper time. On the other hand, if a flaw is not detected by the first flaw-sensor 24, but by a later flaw sensor, the flaw-indicating signal is stored initially in the corresponding later memory and transfer unit and transferred through succeeding memory and transfer units, if any, to the selection control device in the same manner described previously. As will be described later, the several sensing stations are preferably positioned along the track so that a large portion, and ideally substantially all, of the circumference of the object is monitored during passage through the complete array of stations, and the individual stations and their component elements are so positioned that flaw-indicating signals can pass through the several memory and transfer units in sequence in response to detection of flaws in immediately successive cans without mutual interference, whether the spacing between cans is small or large.

With the foregoing general description of a system embodying the invention in mind, a specific embodiment of the invention will now be described in detail in a form suitable for the following purposes. It is common to apply labels to the outer cylindrical surfaces of metal cans as the cans roll in sequence along a track. It is generally

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intended that the label be affixed tightly throughout its area to the cylindrical surface of the can, and centered between the ends of the can so that no large area of the can is exposed. However, due to inevitable occasional faulty operation of the label-applying apparatus the can may be improperly labelled. For example, the label may not adhere at all, in which case the entire metallic can is exposed. In other cases, the label may be applied so that one end of it extends outwardly from the surface of the can forming an undesirable protruding flap; again, the ends of the label may be properly affixed but intermediate portions may not be properly attached to the can so that an outward bulging of the label occurs. In addition, even if the label is throughout its area tightly affixed to the cylindrical surface of the can, it may be located too near to one end of the can, in which case it will generally leave a substantial area exposed at the opposite end of the can. The latter fault, and the fault in which no label at all is attached, will be referred to herein for convenience as the "bare can" condition. The described condition in which the label bulges or flaps will be described or referred to herein as the "loose label" condition. It is such defectively labelled cans, rolling along a track, which it is the purpose of the present embodiment of the invention to detect and divert from the main track.

Referring now particularly to FIGURES 2 and 3, there is provided a track having two portions 50 and 50A bridged by a controllable selector mechanism 52, the track having two spaced rails and associated guide means providing a suitable path for a series of rolling cylindrical cans, such as 54, having the usual protruding rims at each end which ride along the track. The selector mechanism 52 may be of conventional form, typically comprising a first pair of opposed pivotable side members 58 normally spring-tensioned inwardly of the track and two additional pairs 60 and 62 of opposed slidable members also spring-tensioned inwardly of the track, normally to provide a continuous trackway for rolling cans between portions 50 and 50A of the track. A pair of solenoid-operated devices 63 and 64 are provided with arms 66 and 68 fastened to different ones of the pair of members 58, so that upon application of a suitable current to the solenoid-operated devices 63 and 64, each of the members 58 is pivoted outwardly of the trackway sufficiently to remove support for the rims of the cans, thus permitting the cans to fall downwardly onto a removal track 69, members 58 then springing back into place after termination of the applied electrical currents to complete the track for subsequent cans. The pairs of members 60 and 62 provide an outwardly-resilient portion of the track facilitating the motion of any rejected can downwardly onto the rejection track 69. This portion of the apparatus is therefore effective to remove from the main track any selected can in response to electrical current applied to the control devices 63 and 64, and may be of any well-known form suitable for this purpose.

Cans entering the track from the right roll with a velocity which may be imparted to them by any convenient means, whether a positive mechanical drive or a gravity feed. In either event it is contemplated that the velocity and spacing of the cans may vary substantially from time to time. In the present example the cans are understood to enter the apparatus of FIGURES 2 and 3 after leaving a labelling station in which labels are intended to be applied around the cylindrical portions thereof. However, as mentioned previously, some of these will exhibit the "bare can" condition or the "loose label" condition—i.e. the labels may be misapplied so that they extend substantially outwardly from the cylindrical surfaces of the cans, or so that relatively large areas of the cylindrical surfaces of the cans are not covered by the labels at one or the other of the can ends, and in some cases no label may be applied at all. To detect the "bare can" condition, there are provided four pairs 70, 72, 74 and 76 of spring-tensioned electrical contactors, the several pairs being spaced

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from each other along track portion 50 and the individual contactors in each pair being spaced from each other across the trackway. In the present case these electrical contactors are biased upwardly from beneath the trackway so as to contact the bare metal of a can having its label misplaced and thereby complete an electrical circuit from the contactor through the metal of the can to the metal track on which the rims of the can ride. A voltage source connected between each contactor and the track will then produce a current flow if the label is misplaced or completely absent. Similar operation can be produced by positioning the contactors to contact the cans from above, rather than below.

In operation, when a can rolls along the track portion 50 from the input end thereof a current pulse is produced through any one of the electrical contactors 70, 72, 74 and 76 which is contacted by a bare portion of a metal can as it rolls over the track, thus providing an electrical indication at the position of each pair of contactors of the "bare can" condition referred to above.

To detect the "loose label" condition of a can there are provided, adjacent one side of track portion 50, four light sources 80, 82, 84 and 86, and on the opposite side of track portion 50 there are located four "loose label" detector photocell arrangements 90, 92, 94 and 96 each directed obliquely across the trackway toward light sources 80, 82, 84 and 86 respectively.

As shown particularly in FIGURES 2, 3, 4 and 5, the above-described "loose-label" condition is detected at each of four positions along track portion 50 by locating each light source and corresponding photocell so that a straight line between them extends just above the maximum height of a rolling can as it passes along track portion 50 with its label properly affixed. Under these conditions, as shown particularly in FIGURES 4 and 5, if the label 100 extends outwardly from the can it will intercept the light ray travelling between at least one of the light sources and its associated "loose-label" detecting photocell. By placing each photocell in series with an appropriate voltage source there is thereby produced an electrical indication of the "loose-label" condition at one or more of the four positions along track portion 50. By placing the light sources and their associated loose label detecting photocells so that the light beam between them travels obliquely across the trackway, the ability to detect the "loose-label" condition is enhanced, since the plane of the protruding label portion tends to lie at right angles to the trackway.

Considerations relating to the optimum spacing of the "bare-can" detectors and the "loose-label" detectors for a given application will be set forth more fully hereinafter.

Also provided in accordance with the invention are four position-indicating photocells 110, 112, 114 and 116, located directly across from light sources 80, 82, 84 and 86 respectively, and disposed to respond to light therefrom. Each of these position-indicating photocells is disposed somewhat lower, toward the bottom of the trackway, than the "loose-label" detecting cells, as shown in FIGURE 3. By connecting each of the position-indicating cells to an appropriate voltage source, a current is produced through each photocell and its associated circuit each time any of the rolling cans reaches it, regardless of the label condition of the can. For example, position-indicating cell 110 is so located as to produce an output signal as the result of passage of a given can 54 in FIGURE 3 from the flaw-detecting position shown in full line to the position shown in broken line at A for which cell 110 is obscured. Position-indicating cells 112, 114 and 116 are similarly positioned with respect to sensors 72, 92, sensors 74 and 94, and sensors 76 and 96, respectively.

Referring now to the electrical schematic diagrams of FIGURES 6A and 6B, it will be understood that terminals 200, 202, 204, 206, 208 of FIGURE 6A are directly connected to corresponding terminals 200', 202', 204', 206' and 208' of FIGURE 6B. In these figures there are represented schematically the pairs of "bare-can" detec-

tors 70, 72, 74 and 76; the light sources 80, 82, 84 and 86; the "loose-label" detecting photocells 90, 92, 94 and 96; the position-indicating photocells 110, 112, 114 and 116; and the solenoid-operated devices 63 and 64 for operating the can selector; all of which are represented in physical form in FIGURES 2 and 3.

In FIGURE 6A a conventional alternating line-voltage source 210 supplies input power to a power supply 212 which, in turn produces three output direct voltages at terminals 214, 216 and 217 which may be negative, ground, and positive, respectively. These latter voltages are utilized to supply biasing and operating supply voltage, by way of supply lines 218, 219 and 220 respectively, to the various portions of the circuit presently to be described. Power supply 212 also provides an alternating current output between terminals 221 and 222 across which there is connected a suitable transformer winding 224 provided with a variable tap 226 for supplying suitable operating current to the four series-connected light sources comprising the lamps 80, 82, 84 and 86. Variation of the position of tap 226 provides adjustment of the intensity of light from the four light sources to control the "loose-label" detection sensitivity of the system. Also connected across the alternating line-voltage source 210 is the parallel combination of the electrical actuating elements of the two above-mentioned solenoid devices 63 and 64, in series with the parallel connection of two sets of relay contacts 227 and 228, which contacts are normally open but are closed upon the occurrence of an actuating current through the relay primary 230 of FIGURE 6B. It is therefore the function of the circuit now to be described to provide an actuating current through the relay primary 230 when and only when a faultily-labelled can to be diverted reaches the selector mechanism 52 of FIGURES 2 and 3.

The circuit for accomplishing this function includes, first, the "loose-label" detecting photocell 90 connected in series with a resistor 240 between the positive supply lead 220 and the negative supply lead 218. In the absence of any loosely-labelled cans, light from lamp 80 reaching photocell 90 causes the resistance of the latter cell to be relatively low, for example 20,000 ohms, and causes the voltage at the interconnection 242 to be more positive than when illumination of photocell 90 is interrupted by a faulty label. The voltage at the interconnection 242 between photocell 90 and resistor 240 is supplied to the base of a PNP transistor 244 connected as an emitter-follower amplifier. Thus transistor 244 has its collector element connected to the negative supply line 218 and its emitter connected through the two series-connected resistors 245 and 246 to the positive supply line 220. The circuit values are preferably selected so that with photocell 90 illuminated the voltage at interconnection 242 supplied to the base of transistor 244 is sufficiently positive to maintain transistor 244 substantially cut off, and under these conditions the voltage at the interconnection 248 between resistors 245 and 246 is relatively highly positive. Preferably a diode 249 having its anode connected to the base of transistor 244 and its cathode connected to grounded supply line 219 is provided to limit the positive-going excursions of the base voltage of transistor 244 to about ground potential.

The voltage at the interconnection 248 is supplied to the base of another transistor 250, so that the latter transistor is normally cut off when photocell 90 is illuminated. Thus the emitter of transistor 250 is connected to ground line 219 through the normally-closed contacts 260 of a magnetically-controlled differential relay having differentially-connected control coils 260A and 260B, the function of which will be described hereinafter, and the collector of transistor 250 is connected to the memory input lead 262 of a memory and transfer unit 266 corresponding to block 40 of FIGURE 1. Lead 268 of unit 266 is connected to the negative supply lead 218, and

hence unit 266 is connected in effect as the collector load for transistor 250.

Input lead 262 is also connected by way of the normally-closed relay contacts 260' and the parallel pair of electrical "bare-can" contactors 70 to the ground lead 219. Accordingly, in the absence of a can at station I photocell 90 is illuminated and transistor 250 is cut off to prevent current flow through input lead 262 to memory and transfer unit 266. At the same time, both of the contactors 70 remain open-circuited so that current cannot flow through 262 from this source. However, when a "bare can" is presented at station I, at least one of contactors 70 will be closed to provide an input current by way of lead 262 to the memory and transfer unit 266. Similarly, if a can is present at station I which exhibits the "loose-label" condition, and the can is turned as it passes station I so that the label intercepts light normally impinging upon photocell 90, the resultant decrease in resistance of photocell 90 will render conductive the transistor 244, thereby also rendering conductive transistor 250, so that in this case also input current is applied to input lead 262 to memory and transfer unit 266. Accordingly, either or both of the "loose-label" and "bare-can" conditions will produce an input current at lead 262 to the memory and transfer unit 266.

In the present example the memory and transfer unit 266 comprises the two differentially-connected control coils 260A and 260B for controlling the normally-closed contacts 260, 260' and 260''. As indicated by the dots adjacent these coils, if current flows downwardly through both of control coils 260A and 260B, or if there is no current in either, the controlled contacts 260, 260' and 260'' remain in their respective normal conditions; current through either control coil alone quickly actuates the contacts to their opposite condition. It is noted that input lead 262 is connected through the series combination of control coil 260B and diode 300 to the negative supply line 218, while control coil 260A and diode 302 are connected in series between the same two points. Both diode 300 and diode 302 are poled to conduct only when lead 262 is made positive by turning on of the transistor 250 or actuation of contactors 70.

Memory and transfer unit 266 also comprises the two differentially-connected control coils 306A and 306B which are associated with, and control the opening and closing of, the normally open contacts 306 and normally-closed contacts 306'. More particularly, the series combination of coil 306B and resistor 308 is connected in parallel with coil 260A, while coil 306A is connected between negative supply lead 218 and the anode of a diode 310 having its cathode connected to the interconnection 312 between the upper ends of coils 306B and 260A. Contacts 306 are connected between the interconnection 312 and the ground supply lead 219.

The storage function of the memory and transfer unit 266 occurs as follows. When closing of the contactors 70, or interruption of the light to photocell 90, in response to arrival of a faultily-labeled can at station I causes lead 262 to become positive with respect to the negative supply lead 218, current flows downwardly through coils 260B, 260A and 306B, but it is prevented from flowing through coil 306A by diode 310. The currents through coils 260A and 260B, occurring simultaneously, do not actuate contacts 260, 260' and 260'', but leave them in their normal conditions. However, the current through coil 306B occurring in the absence of a balancing current through coil 306A, causes actuation of contacts 306' to their open condition and contacts 306 to their closed condition, thus connecting interconnection 312 to the ground supply lead 219, with the result that coils 306B and 260A are also supplied with downward current by way of closed contacts 306. With these conditions established, motion of the faultily-labelled can beyond contactors 70, and beyond the line of interruption of the light beam directed toward photo-

cell 90, terminates current flow by way of lead 262 into memory and transfer unit 266, but current continues to flow downward through coils 306B and 260A by way of the actuated, closed contacts 306. The resultant current through coil 306B causes contacts 306 to remain closed, and the resultant downward current through coil 260A, in the absence of current through coil 260B, causes contacts 260 and 260' to be actuated to their open conditions and 260' to its closed position. This condition of current flow through coils 306B and 260A is self-sustaining, and constitutes storage of a flaw-indicating signal in the memory and transfer unit 266.

Transfer of the stored signal out of unit 266 and into the next succeeding memory and transfer unit 320, and resetting of unit 266 to its original condition, is accomplished when the same faulty can which produced the stored signal in 266 moves sufficiently past the "bare-can" and "loose-label" detecting apparatus to intercept light normally impinging upon the position-indicating photocell 110 of station I. Photocell 110 is connected in series with resistor 322 between the positive supply line 220 and the negative supply line 218. The interconnection 324 between photocell 110 and resistor 322 is connected to the base of PNP transistor 326, and preferably also through an appropriate clamping diode 328 to the grounded supply line 219, as in the case of the previously-described diode 249 and for similar purposes. Transistor 326 has its emitter connected by way of series-connected resistors 330 and 332 to the positive supply line 220, the interconnection 334 thereof being connected to the base of the PNP transistor 336.

The just-described electrical elements associated with the position-indicating photocell 110 may be substantially identical in construction and operation with corresponding elements described above in connection with the circuitry connected with the "loose-label" detecting photocell 90. However, in the present case the emitter of transistor 336 is connected to the grounded supply line 219 by way of contacts 260' which are normally open, rather than closed, and the collector of transistor 336 is connected to the interconnection between diode 310 and the uppermost terminal of coil 306A by way of the transfer command signal input lead 338 of unit 266. It is understood that normally-open contacts 260' are associated with the control coils 260A and 260B so as to be actuated to a closed condition only when current flows downwardly through but one of the two control coils 260A and 260B. Accordingly, if no signal is stored in unit 266 then open contacts 260' will prevent conduction through transistor 336 even when position-indicating cell 110 is actuated. However, with a stored signal in unit 266, contacts 260' are closed by current through coil 260A, and actuation of the position-indicating cell 110 then renders transistor 336 conductive to apply substantially ground potential to trigger command input lead 338, thereby to produce a current downwardly through control coils 306A, 306B and 260A. Since current then flows downwardly through both of coils 306A and 306B, the normally-open contacts 306, which are closed during storage time, return to their normally-open condition, contacts 260' remaining closed and contacts 260 and 260' remaining open until the transfer command pulse has been terminated by passage of the can past the point in station I at which it intercepts light directed toward photocell 110. At this latter time transistor 336 becomes non-conductive, thus cutting off all current flow through memory and transfer unit 266, eliminating current in all of the control coils of the unit 266, and thereby returning it to its original condition which it possessed prior to all input signals thereto; contacts 260', 260'' and 260 also then return to their respective normal conditions ready for actuation by the next successive faulty can. In this manner the trigger command signal input at lead 338 accomplishes resetting of memory and transfer unit 266 to its original condition. At the same time, the signal

previously stored in unit 266 is transferred to the next succeeding memory and transfer unit 320 of station II, as will now be described.

Memory and transfer unit 320 of station II is provided with a memory input lead 342 connected to the collector of a transistor 344 and to the pair of contactors 72 by way of normally-closed contacts 345 exactly as in the arrangement described above with respect to station I and unit 266, the structure and operation of unit 320, of contactor 72, and of transistor 344 and its associated connections to the "loose-label" detecting cell 92 of station II being substantially identical with the corresponding elements at station I. However, in the case of station II the input lead 342 to the memory and transfer unit 320 is also connected to the ground supply lead 219 by way of the series combination of normally-closed contacts 306' associated with and actuated by the control coils 306A and 306B described above, and the normally-open contacts 260''' associated with and actuated by the control coils 260A and 260B described above. Accordingly, during the above-described storage interval of unit 266 when current is flowing downwardly through coil 306B but not through coil 306A, contacts 306' are actuated to their open condition, and when the flaw-indicating signal into unit 266 terminates the downward current through coil 260A in the absence of current through coil 260B causes normally-open contacts 260''' to be closed. The result is that during the storage interval for unit 266, current cannot flow by way of contacts 306' and 260'''; however, upon the occurrence of the transfer command signal at input lead 338 to unit 266 caused by arrival of the can at photocell 110, the downward current produced through both of coils 306A and 306B causes contacts 306' to revert to their normally-closed condition, while contacts 260''' are still actuated to their closed condition by the downward current through coil 260A. Accordingly at the latter time a path is completed from the ground supply lead 219 to the memory input lead 342 of memory and transfer unit 320. As a result the position-indicating signal produced by photocell 110 when the can reaches it causes the stored signal removed from unit 266 to be transferred to, and stored in, the next subsequent memory and transfer circuit 320.

It will be appreciated that if neither the "loose-label" indicating photocell 90 nor the contactor 70 of stage I produces a flaw-indicating signal for a given can, there will be no signal stored in memory and transfer unit 266, and hence none will be transferred to the next succeeding unit 320. However, if a flaw-indicating signal is produced by "loose-label" detecting photocell 92 or contactors 72 of station II, a flaw-indicating signal will be stored in memory and transfer circuit 320 in the same manner as described previously with respect to unit 266. In addition, if a signal previously stored in unit 266 has been transferred in the manner described above into the unit 320, and an additional flaw-indicating signal is later produced at station II, a memory input signal will not be produced thereby at lead 342 since the normally-closed contacts 400 at station II will be open due to the storage condition existing in unit 320.

The structure and operation of the succeeding stages III and IV may be identical with that described with respect to stations I and II, with the exception that the output circuit of station IV differs somewhat for the purpose of operating the can selector mechanism. In particular, the position-indicating signal produced by photocell 112 when the can reaches the latter cell will cause transfer from memory and transfer unit 320 to station III memory and transfer unit 350 of FIGURE 6B, and a position-indicating signal from photocell 114 will cause similar transfer of any signals stored in memory and transfer circuit 350 to the next succeeding memory and transfer unit 352 of station IV. At the

same time, if there is no signal to be transferred into a given memory and transfer unit then any new flaw-indicating signal derived by any of the contactors or "loose-label" detecting photocells will be stored in the corresponding memory and transfer unit and thereafter will travel from one memory and transfer unit to the next as controlled and commanded by the position-indicating signals.

When a signal has been stored in the last memory and transfer unit 352, movement of the can to a position to actuate the position-indicating photocell 116 causes any signals stored in unit 352 to operate the selector mechanism. While the final selector control circuit shown and described in the above-mentioned copending application may be used for this purpose, the circuit now to be described has been found more effective and reliable. The differential relay comprising the differential control coils 400A and 400B, normally-open storage control contacts 400' and normally-closed contacts 400'' actuates contacts 400'' when current flows through only one of the control coils in a given direction; and the differential relay comprising differential control coils 402A and 402B, normally-open contacts 402' and other contacts similar to those in earlier stages actuates contacts 402' when current flows through only one of the latter control coils in a given direction. The arrangement is therefore like that described above with reference to contacts 260''' and 306' in the transfer circuit of stage I, and, similarly to the action in stage I, arrival of a can at position-sensing photocell 116 causes any flaw-indicating signal stored in memory and transfer unit 352 to be transferred to the selector operating circuit by holding contacts 402' in their closed condition and allowing contacts 400'' to return to their normally-closed condition. As a result current flows from supply lead 220 to supply lead 218 by way of relay control coil 230 to close contacts 227, 228 of FIGURE 6A, actuate solenoids 63 and 64, and thereby operate the can selection mechanism.

In this form of selector circuit the upper or more-positive end of relay coil 230 is also connected to the positive supply lead 220 by the series combination of normally-open relay contacts 230', resistor 234, capacitor 236 and resistor 240 in that order, a normally-closed pair of relay contacts 230'' also being connected in parallel with resistor 234 and capacitor 236 as shown. Relay contacts 230' and 230'' are actuated by relay 230. The function of this circuit is to provide a desired amount of delay in de-actuation of relay 230 after a can to be selected has past position-indicating photocell 116 and contacts 402' have therefore opened, the delay depending on the capacitance of the capacitor and the resistance of the resistors. Such delay is desirable in many cases to permit reliable and rapid sequential selection of cans. In operation, transfer of a flaw-indicating signal to relay 230 opens contacts 230'' which had previously shunted capacitor 236 and resistor 234, and also closes contacts 230'. This does not alter operation of relay 230 while contacts 402' remain closed but, when the latter contacts reopen following passage of the can, current continues to flow through relay 230 to capacitor 236 to charge the capacitor until the charging current falls to the drop-out level of relay 230, contacts 230' reopen, and contacts 230'' reclose to complete the cycle.

A primary function and purpose of the relay contacts such as 260'' and 260 in stage I, which are preferably used in each of the four stages as shown, it as follows. When the cans on the track are not extremely close to each other, for example, are not in actual contact, and cans are all of the exact size for which the positions of the various sensing devices were designed, highly-reliable faulty-can selection is obtained without contacts such as 260'' in any of the stages and without contacts 260 in the first stage; however without these contacts and with very close can spacings, in some instances an occasional

faulty can may be missed, for the following reasons. When a flaw-indicating signal has been stored in a memory and transfer unit such as 266 of stage I, and the corresponding can then moves to the position in which it first reaches the associated position-indicating photocell, a transfer command signal is initiated which permits contacts 306' to re-close and which normally holds contacts 260''' closed so long as the can is passing the photocell. It is during the latter time that the fault-indicating stored signal is transferred to the next stage, or to the can selector circuit in the case of the last stage. However if a closely-following faulty can is able to actuate the flaw-sensor of the same stage before the leading can has completely passed the position-indicating photocell, the effective transfer interval may be terminated prematurely. For example, if in the first stage a succeeding can were to actuate the "bare-can" detector 70 during the transfer command time for the preceding can, coils 260A and 260B would both conduct, thus opening contacts 260''' and arresting current flow into the next memory and transfer unit 320. Since the transfer action requires some time, if the interval for transfer is thereby made too short effective transfer may not occur. This is especially true for the last stage, since the relay 230 for operating the selector mechanism is usually larger and slower-acting than the relays in the preceding stages.

Such interference with effective transfer is positively prevented by the contacts such as 260 and 260'' in each stage. Once storage has occurred these contacts are positively held open by the action of coils 260A and 260B until transfer is complete, first by the closing of storage contacts 306 and later by the transfer command signal itself, as described above. Accordingly no interfering flaw-indicating signal from a succeeding can can enter any of the memory and transfer units until effective transfer is complete.

In the preferred form of the invention the entire length of track along which the flaw-sensing apparatus is disposed is approximately equal to or slightly longer than the circumference of the cans at their rolling diameters, in this case the circumference of the rims of the cans at the ends thereof. Furthermore, the spacings between each "loose-label" detecting photocell and its associated following position-indicating photocell is preferably slightly less than the diameter of the can. In any event the spacing along the track of the various elements is preferably such that the above-described generation of flaw-detecting signals from a given can, storage of the flaw-detecting signals in a memory unit, arrival of the same can at the next position-indicating cell, and transfer out of the corresponding memory and transfer unit, occur in the order stated, and such that even if immediately successive cans are travelling with substantially zero spacing between them the above-recited sequence of operations will be produced in response to one particular can.

It will be appreciated that in this manner there is provided apparatus which provides effective inspection of the labelling of the cans at four circumferentially-spaced regions thereof, so as to monitor substantially completely the entire circumference of the can for labelling defects, and in which any flaw-detecting signals produced at any station are delayed in their application to the selector mechanism by precisely the proper amount to assure final selection of the corresponding faulty can, by causing the flaw-indicating signals to advance from circuit-to-circuit from the point of detection to the selector mechanism in steps the times of occurrence of which are determined entirely by the position of the corresponding can, so as to operate the selector at the proper time despite variations in velocity or spacing of the various cans.

The following are typical examples of the parameters of one form of a system employing the invention, in which accurate selection of faultily-labelled cans was obtained for can flow rates of more than one thousand per minute.

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Diameter of cans at their rims	About $2\frac{1}{16}$ in.	
Diameter of body portions of cans	About $2\frac{1}{32}$ in.	
Spacing between centers of photocells	About $2\frac{3}{16}$ in.	5
Position of "loose-label" detecting photocells	Immediately above the rims of the cans.	
Location of position-indicating photocells	About $\frac{1}{2}$ inch below the center of the "loose-label" detecting photocells.	10
Power supply voltages	Ground, +24 volts and -24 volts.	15
"Loose-label" detecting and position-indicating photocells	Lead selenide photocells.	20

In this preferred embodiment the positioning of the photocells with respect to the can insures that a flaw-indicating signal produced by a given can is stored after the corresponding memory and transfer unit has been cleared of any earlier-stored information, and is transferred only in response to later actuation of the associated position-indicating cell by the same can, even though successive cans may be so close together along the track as to touch each other.

While the invention has been described with particular reference to a specific embodiment thereof, it may be embodied in any of a wide diversity of forms differing from those specifically described, as will occur to one skilled in the art in view of the foregoing description. Accordingly, the invention is to be limited only by the appended claims.

I claim:

1. Apparatus for selecting from a train of objects moving along a predetermined path those objects having a particular identifying characteristic, comprising:

means for monitoring said objects at a first plurality of spaced locations along said path to produce at said locations a plurality of separate sequential signals indicative of the presence of said identifying characteristic in certain of said objects;

means for sensing the positions of said objects at a second plurality of locations along said path and for producing separate sequential signals indicative of the attainment of said positions by said objects;

selector means having a control element responsive to control signals applied thereto for selecting objects from said train at a location along said path situated beyond said first and second plurality of locations in the direction of motion of said objects;

means for delaying said signals indicative of the presence of said identifying characteristic, and for applying said delayed signals to said control element of said selector means; and

means responsive to said position-indicating signals for independently varying said delay of each of said signals indicative of said identifying characteristic, in accordance with the rate of movement along said path of the object producing said last-named signal, thereby to operate said selector means when said last-named object reaches it.

2. Apparatus for automatically selecting an object having an identifying characteristic from a train of objects moving along a predetermined path, comprising:

means for sensing said characteristic at a predetermined first plural set of spaced locations along said path, said means producing a separate signal indicative of said characteristic at each of said spaced locations;

means for separately storing each of said separate signals;

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means for sensing the positions of said objects at a predetermined second plural set of locations along said path, each of said locations of said second set being spaced adjacent and beyond a different one of said locations of said first set in the direction of motion of said objects along said path, said position-sensing means producing a separate signal indicative of said positions, at each of said second set of locations;

selector means responsive to signals supplied to a control element thereof to select objects from said train at a location beyond said first and second sets of locations in the direction of motion of said objects; and

means responsive to said separate position-indicating signals for transferring each of said separately-stored signals to said control element of said selector means only when the object producing said each separately-stored signal passes the last of said second set of locations.

3. Apparatus for automatically selecting flaw-containing cans from a train of cylindrically-surfaced cans rolling along a track, comprising:

a plurality of detection stations disposed in predetermined order along a portion of said path, each of said stations being responsive to passage of said cans of said train to produce a position-indicating signal upon the attainment by each of said cans of said train of a predetermined position adjacent said each station, each of said stations also being responsive to passage by it of cans of said train having a flaw to be detected to produce a flaw-indicating signal; selecting means disposed beyond said stations in the direction of movement of said cans and having a control element responsive to control signals supplied thereto to select a can from said train after it has passed said stations;

a plurality of signal storage means equal in number to said plurality of detection stations, each of said storage means having an input terminal, a control terminal and an output terminal and being supplied at its input terminal with said flaw-indicating signal from a different corresponding one of said detection stations to store said last-named signal therein, each of said storage means being supplied at its control terminal with said position-indicating signal from the corresponding one of said detection stations to shift any flaw-indicating signal stored therein to said output terminal thereof;

means connecting said control element of said selecting means to the output terminal of that one of said plurality of storage means the control terminal of which is supplied with a position-indicating signal from that one of said stations immediately preceding said selecting means; and

means connecting said output terminal of each of said storage means, other than said one storage means, to the input terminal of the next succeeding one of said storage means.

4. Apparatus for selecting from a train of cylindrical cans those cans exhibiting a predetermined type of flaw, comprising:

a main track for conveying a train of rolling cylindrical cans;

a selector mechanism responsive to a control signal applied thereto to divert a can from said main track;

a first can-monitoring station preceding said selector mechanism along said main track for producing first time-spaced flaw-indicating signals in response to, and substantially concurrently with, reaching of a first predetermined section of said station by cans of said train exhibiting said type of flaw, and for producing first time-spaced position-indicating signals as said cans of said train reach a second predetermined section of said station following said first section;

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a second can-monitoring station disposed along said track between said first station and said selector mechanism for producing second time-spaced flaw-indicating signals in response to, and substantially concurrently with, reaching of a first predetermined section of said second station by cans of said train exhibiting said type of flaw, and for producing second time-spaced position-indicating signals as said cans of said train reach a second section of said second station following said first section thereof;

first memory and transfer means supplied with said first time-spaced flaw-indicating signals and with said first time-spaced position-indicating signals, and responsive thereto to store each of said first time-spaced flaw-indicating signals until the occurrence at said first memory and transfer means of the next one of said first time-spaced position-indicating signals;

second memory and transfer means supplied with said second time-spaced flaw-indicating signals and with said second time-spaced position-indicating signals, and responsive thereto to store each of said second time-spaced flaw-indicating signals until the occurrence at said second memory and transfer means of the next one of said second time-spaced position-indicating signals;

means for transferring any signal stored in said first first memory and transfer means to said second memory and transfer means upon said occurrence of the next one of said first time-spaced position-indicating signals; and

means for transferring any signal stored in said second memory and transfer means to said selector means upon said occurrence of the next one of said second time-spaced position-indicating signals.

5. Apparatus in accordance with claim 4, in which the spacing between said first and second sections in each of said stations is sufficiently small to prevent a signal, stored in one of said memory and transfer means in response to a flaw-indicating signal derived from a given can, from being transferred therefrom in response to a position-indicating signal produced by a preceding can.

6. Apparatus in accordance with claim 5, in which the spacing between said first and second sections at each of said stations is less than the diameter of each of said cans.

7. Apparatus in accordance with claim 4, in which each of said memory and transfer means comprises a binary storage circuit settable to a reference state in response to said position-indicating signals applied thereto and actuatable to an alternate state in response to said flaw-indicating signals applied thereto from said first sections of said stations, said second memory and transfer means also being responsive to signals transferred thereto from said first memory and transfer means to exhibit said alternate state.

8. Apparatus in accordance with claim 4, in which each of said first and second stations is effective to monitor less than the entire circumference of each of said cans, said first and second stations being positioned along said track so as to monitor different circumferential portions of each of said cans.

9. Apparatus in accordance with claim 4, in which said second section in each of said stations comprises a photo-responsive device and a light source transmitting light across said track to said device along a predetermined line, said line lying below the tops of said cans of said train.

10. Apparatus in accordance with claim 9, in which said first section in each of said stations comprises a photocell responsive only to light which reaches it along a path lying above the tops of said cans of said train.

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11. In apparatus for generating, storing and transferring electrical indications of flaws in objects moving in a train along a track;

a first sensing station disposed at a first location along said track for producing a first flaw-indicating electrical signal in response to detection thereby of a fault in a can moving past said station on said track, and for producing a first position-indicating electrical signal after said production of said flaw-indicating signal as said can moves past a predetermined position at said first location; and

a first memory and transfer unit comprising first, second, third and fourth differential relay coils, a first pair of normally-open relay contacts, a second pair of normally-open relay contacts, and a third pair of normally-closed relay contacts, said first pair of contacts being actuated to their closed position in response to the occurrence of actuating current through only one of said third and fourth coils, said second pair of contacts being actuated to their closed position in response to the occurrence of actuating current through only one of said first and second coils, said third pair of contacts being actuated to their open position in response to the occurrence of actuating current through only one of said third and fourth pairs of contacts, means responsive to said first flaw-indicating signal to produce a pulse of actuating current through only said first, second and third coils thereby momentarily to open said third pair of contacts and to close said first pair of contacts, means for supplying actuating current to only said second and third coils by way of said first pair of contacts continuously while said first pair of contacts are closed thereby to maintain said first and third contacts closed and open respectively and to close said second pair of contacts after said flaw-indicating signal is ended, means responsive to said position-indicating signal for producing a pulse of actuating current through only said second, third and fourth coils thereby to maintain said second pair of contacts closed and to permit said first and third contacts to re-close, and a voltage source connected in series with said second and third pairs of contacts, whereby said position-indicating signal produces a pulse of current through said second and third pairs of contacts after the occurrence of a flaw-indicating signal from the corresponding object, all of said actuating currents terminating with the termination of said position indicating-signal to return said memory and transfer unit to its original state.

12. In apparatus in accordance with claim 11, a fourth pair of relay contacts connected normally to permit said flow of said pulse of actuating current through only said first, second and third coils but responsive to flow of actuating current through only one of said first and second coils to prevent application of flaw-indicating signals to said first coil, thereby to prevent premature termination of said pulse of current through said second and third pairs of contacts by a flaw-indicating signal occurring subsequent to the start of said position-indicating signal.

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